Is There a Customer Relationship Effect from Bank ATM Surcharges?

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This paper investigates the use of ATM surcharges as a strategic device to increase bank profitability. We show that ATM surcharge changes can have both a direct effect on bank profitability and an indirect effect via customer switching and a related customer relationship effect. That is, customer switching results in an increase in the demand for other services provided by the surcharge increasing bank. Using unique data bases, we provide evidence to show that overall bank profitability is favorably affected by surcharge increases. We also show evidence supporting the existence of an indirect effect, especially for larger banks.

I. Introduction

Although the number of U.S. banks continues to decline there has been sustained growth in ATM networks and the number of ATMs. According to Dove (2002) virtually every U.S. bank is now a member of a shared network (such as Plus, NYCE and Cirrus). Moreover, the number of ATMs had grown to over 324,000 as of the end of 2001 (see, Sienkiewicz (2002)). This proliferation of ATMs has occurred despite apparent complaints by bankers about the fixed and variable costs associated with the new ATMs added to their networks (Dove, 2002). One possible reason for the willingness of bankers to keep adding ATMs is that the revenue generated from these machines, in the form of direct surcharges to non-bank customers (so-called foreign customers) as well as other fees[1] outweighs the costs of ATM addition. Indeed, since April 1st 1996 banks that are members of shared networks have generally been free to set their own surcharges for nonbank (foreign) customer use of their ATMs[2] (see, Hannan, Kiser, Prager, McAndrews (2002)). Thus, one reason underlying ATM proliferation is that foreign (non-bank) customer surcharges --so called ATM surcharges-- have made adding ATMs to a bank's network profitable, even in the presence of higher marginal costs. Indeed, revenues from surcharges were estimated to exceed $2 billion in 2001 alone (Dove 2002)[3]. Industry observers and economists have labeled this the "direct effect" on bank profits resulting from surcharging (see, for example, Dove (2002), Hannan, *et al* (2002) and Massoud and Bernhardt (2002a and 2002b)).

Increasingly, however, bankers and economists are arguing that there is also a second, or indirect effect, that emanates from ATM proliferation and surcharging. Indeed, one striking result of a recent Dove (2002) survey of banks is that over 50% of large financial institutions recognized that there may be an "indirect effect" or customer relationship effect from ATMs that

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[1] Other fee revenues include a fee charged to a bank's own customer who uses another bank's ATMs (a so-called foreign fee) as well as interchange fees paid by the customers bank to the ATM owner when the bank's own customer uses the owners ATM. The latter fee is usually set by the network and is constant across all banks in a network. Other fees that may be paid or charged include: own-bank ATM fee (which is rare), POS fee, card fee and switch fee (see Stavins, 2000 p. 15).

[2] Until April 1st 1996 major shared networks such as Cirrus and Plus prohibited ATM surcharges on other network bank customers. This surcharge ban was eliminated on April 1st 1996 and surcharges began to proliferate soon after. Moreover, surcharging was prohibited in a number of states prior to 1996 (Prager 2001).

[3] Berger and Mester (1999) have argued that banks become far more focused on revenue generation in the 1990s relative to the 1980s.

can generate additional profits[4] for a bank. In a recent study by bankers, Armstrong, Barron and Elgas (2002) a key aspect of their simulations was a modeling of the switching effect. This indirect effect has also been recognized in the theoretical papers of Massoud and Bernhardt (2002a and 2002b) and McAndrews (2002).

While greater ATM proliferation may well attract more customers, due to considerations of convenience, the indirect impact of surcharges on total bank profits may be less clear. The argument here is that if consumers are forced to pay higher surcharge fees on cash transactions they face an incentive to "switch" to the bank charging the higher fees so as to avoid paying those fees. This is because only "foreign" customers, who are not account members of that bank, will pay an ATM surcharge. If this switching behavior occurs, then these customers will presumably purchase a variety of other bank products, which in turn will increase bank revenues and profits[5]. While a variety of papers in the literature (Massoud and Bernhardt (2002a, 2002b) McAndrews (2002) and Hannan *et al* (2002)) have described or modeled the direct and indirect effects, this paper is the first to specifically test for the impact of these effects on bank profitability. We are able to do this because we have access to a unique data set containing information, among other things, on bank ATM surcharges, ATM network size, ATM geographic dispersion, monthly total ATM transactions, the percentage of foreigners using ATMs for each of these banks and other key bank ATM variables. Consequently, the major contribution of this paper is that it estimates how a strategic variable controlled by bank managers, in this case ATM surcharges, impacts various outcomes that are of importance to bank profitability, through either the direct or indirect effects described above. Of particular interest is how a bank's ATM surcharge impacts its overall profitability. In addition, we trace whether there is also evidence consistent with the impact of an indirect effect of ATM surcharges on bank profitability. This is done by examining a two-step process. In the first step, we examine how bank surcharges impact the percentage of ATM users that are not bank customers (so-called foreign customers). A finding of a high surcharge being associated with low foreign percent usage would be consistent with (high) surcharges inducing foreign customers --especially those

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[4] According to the Dove (2002) report, 50% of large financial institutions recognized that ATM deployment and pricing could be used to attract customers to other bank products. For example, a banker quoted from the Dove report p. 110 regarding the advantages underlying extensive ATM networks observed that such networks provided a bank with "the ability to leverage 18 million transactions per month into cross-sell opportunities for our products and services."

[5] Mester, Nakaumura and Renault (2003) also show that there is a link between customer checking accounts and the information they generate and other services (such as the provision of loans).

of small banks with limited networks-- to switch their deposit accounts to larger banks' charging relatively high surcharges so as to avoid such transaction costs.

The second step is to analyze how surcharges impact the demand for bank services. A finding of a link between the ATM surcharge and the demand for bank services would be consistent with an indirect affect --one that appears to reflect a customer relationship effect[6]. To proxy for bank services we analyze the sensitivity of depositor growth, total deposits and total loans to ATM surcharges.

Since surcharge fees are a fixed dollar amount per transaction then larger surcharge fees could lead to customers withdrawing bigger amounts less frequently from foreign banks instead of switching their accounts (i.e. a downward sloping demand curve). We attempt to account for this in out tests by employing ATM usage measures (e.g. total transactions per ATM and foreign transactions per ATM) as control variables. Moreover, switching is a two part story, as discussed in the paragraph above. A finding of high surcharges increasing product demand, in conjunction with a finding of a high surcharges reducing the foreign percentage, would be consistent with the switching story.

Finally, we analyze the relative effects of ATM surcharge liberalization (post-1996) on the profitability of small banks versus large banks. For example, while it has been argued that branching and merger restrictions have often favored smaller banks (see Economides, Hubbard and Palia (1996) and Palia (1994) for example) the expansion of ATMs and ATM price liberalization has been viewed as favoring larger banks over smaller banks (see Public Interest Research Group (1999))[7]. This is because, if surcharges are being increased, customers will have an incentive to switch from smaller banks to larger banks with bigger networks, although this is disputed by the American Bankers Association (1997).

Analyzing the effect of the ATM surcharge on bank profitability and its impact on profit, via the direct and indirect channels, is different from much of the prior empirical research in this area, which has tended to focus on conditions (e.g., bank size, market concentration etc..) under which a bank may or may not impose a surcharge and/or whether the surcharge is high or low (e.g., Hannan *et al*, (2002), Stavins (2000)).

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[6] For detailed discussion of customer relationship effects in a different context see, Onenga and Smith (2001) and Bae, Kang and Lim (2002).

[7] A similar public policy concern has been raised about the negative effects of bank merger policy liberalization. However, Berger *et al.* (1998) find no support for their view in the case of small business lending.

Section 2 of this paper briefly provides an overview of ATM growth and pricing. Section 3 reviews the previous literature on ATM pricing. Section 4 assesses the ex-ante materiality of the April 1st 1996 liberalization of ATM surcharges announced by Cirrus and Plus. Section 5 presents a model that shows how ATM surcharges impact a bank's profitability through both a direct and indirect channel. Section 6 discusses our hypotheses and empirical methodology. Section 7 discusses the empirical results and finally Section 8 is a summary and conclusion. An Appendix to the paper describes in detail the ATM data employed in this study provided by Dove Consulting group (1999) and (2002)) – henceforth Dove.

2. ATM Proliferation and Pricing

The number of ATMs have grown significantly since being introduced in the late 1960s. For example, the number of ATMs stood at 324,000 in 2001 versus 83,000 in 1991. There have been at least three phases of growth identified (see Dove (2002)). The first phase was pre-1996, i.e., pre-independent surcharging, when there was a relatively modest growth in ATMs. The second phase was 1996 to approximately 1998 when there was rapid ATM growth following the relaxation of restrictions on individual bank surcharges in April 1996. The most recent period (*i.e.,* post 1998) has reflected slower growth again.[8]

When a customer uses ATMs' of banks other than his or her own (a so-called foreign customer) he or she is charged at least two separate fees: (i) a surcharge fee by the bank which owns the ATM and (ii) a foreign fee by his or her own bank for using ATMs of other banks.[9]

Prior to April 1st 1996, banks' were generally restricted by ATM shared networks from imposing surcharge fees on foreign customers who used ATMs in the shared network other than those of their own bank. On April 1st 1996 Cirrus and Plus announced that they were willing to let members of their networks determine their own surcharge fees. Since that time the number of banks charging such fees to foreign users has increased rapidly. By 1998 (only two years later) 78% of US banks were imposing surcharge fees (Stavins (2000)). In the Dove (2002) Survey more than 90% of the banks in 2001 imposed ATM surcharges, with larger banks, in general

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[8] According to Dove (2002) the evolution of ATMs has followed the familiar "S" shape common to many innovations.
[9] Stavins (2002) discusses other ATM related fees such as the foreign and interchange fees paid by banks. We do not examine foreign fees or others here since bank specific fee charges other than ATM surcharges were not available from the Dove data base.

imposing higher surcharges than smaller banks (see Dove 2002). Consequently, the surcharge fee has been a focal point of much of the prior ATM literature --discussed next in Section 3.

3. Previous Literature on ATMs and ATM Pricing

Following the dramatic increase in the number of banks applying a surcharge to their foreign customers, there has also been an increase in research on this issue. Massoud and Bernhardt (2002a and 2002b) and McAndrews (2002) have developed theoretical models which introduce and analyze the idea of the indirect effect of ATM surcharging on bank profitability. Other research, e.g., by Hannan *et al* (2002), Prager (1999), Stavins (2000) Prager (2001) have examined empirically various elements of ATM pricing.

Specifically, in some of these papers (e.g., Hannan *et al* (2002) and Stavins (2000)) the empirical tests aim to identify factors that determine either the size of a bank's ATM surcharge and/or whether a bank sets a surcharge or not[10]

This paper takes a different approach, in that it seeks to examine how a bank's strategic choice of its ATM surcharge affects its profitability. In other words, while much of the literature has attempted to explain surcharging levels, our paper examines whether or not surcharges impact key outcomes such as bank profitability. In this way we are better able to test the total effect, as well as the indirect effects, of surcharging on bank profitability and bank product demand. One reason for our ability to examine the indirect effect is that our data (described in detail in the Appendix), which is derived from market surveys by Dove ((1999), (2002)) provides both time-series and cross sectional information on bank surcharges and ATM usage in total and by foreigners. When combined with Call Report data on bank profitability, bank deposits, loans and capital adequacy we are able to develop panel-based insights into how bank strategic variables impact a bank, and in particular, whether or not an indirect effect is present. By

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[10] Hannan *et al* (2002) discuss in some detail the direct effect ("direct revenue generation") and the indirect effect ("strategic motive of attracting customers who wish to avoid paying surcharges"). However, given the nature of their data they are unable to directly test these hypotheses. They use a logit regression to examine which factors and market characteristics will impact the choice of whether or not to impose a surcharge. They find, for example, that the probability of surcharging decreases with ATM share in the market and ATM density while increasing with the importance of minorities in the market population and if the state liberalized early on its regulations on surcharging. They also find the rate of in-migration to the local banking market has significantly positive effects on surcharges. This is consistent with an indirect effect being present *i.e.,* surcharges can induce switching by depositors. Stavins (2000) focuses on the size of ATM networks on surcharges and other fees.

contrast, both the Hannan *et al* (2002) and Stavins (2000) studies are constrained to analyzing a single cross-section of bank surcharges[11].

Moreover, the empirical questions posed by Hannan *et al* (2002) --the factors determining whether or not a bank imposes a surcharge-- were clearly of importance in the context of their 1997 database, when only about half of the banks in their survey imposed ATM surcharges. However, the very large increase in the proportion of banks using independent surcharges since then leads us to ask a different question in this paper – what has been the impact of these surcharges on bank outcomes and, in particular, on bank profitability?

The empirical research by Prager (2001) examines the issue of whether consumers from small banks will switch to larger banks in order to avoid paying a surcharge. This paper does not use bank level data but rather examines state level data comparing the market share of small banks in states (markets) with and without surcharging over the period 1987 to 1995. She concludes that small banks actually did a better job of retaining deposit market share in the presence of surcharging than in its absence. Prager uses this evidence to argue against an indirect effect. While Prager does attempt to examine how surcharging may impact small bank profitability the analysis is conducted in terms of a comparison across markets (states), with and without surcharging, rather than at the individual bank level. Finally, Prager's study covers a period prior to the liberalization of ATM surcharging (and the dramatic growth in ATMs) that occurred after 1996. By comparison our study uses data from the post-liberalization 1996-2001 period.

Finally, since a key component of this paper is the potential profits banks can earn by inducing switching, it is related to growing literature on customer relationship effects in banking (see for example, Ongena and Smith (2001)).

4. The April 1st 1996 Announcement

Before tracing the long term impact of the April 1st 1996 liberalization of surcharges on bank profitability it is important to establish the materiality of the news of this liberalization on both large and small banks. Specifically, what were the market's (and equity investors) expectation regarding the potential impact? To the extent that the market (investors) factored in both direct

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[11] For example, in Hannan *et al* (2002), information about surcharges was collected by Moebs Services in 1997 (on behalf of the Federal Reserve Board) by telephone survey. Stavins (2000) uses data from a survey of financial institutions conducted by Bank Rate Monitor in May 1997.

and indirect effects the more likely it is that the announcement had a material effect on bank stock returns.

To examine this question we conducted a standard event study of the impact of the April 1st 1996 announcement on bank returns and, in particular, the relative impact of this announcement on large versus small banks. A review of the Wall Street Journal Index supported the view that the April 1st 1996 announcement was a relatively clean (unexpected) announcement and that no other major bank-specific news events occurred on that day.

Abnormal returns were calculated for three portfolios of banks: (i) an all bank portfolio containing equally weighted returns on all banks in the Compustat data file who had event day returns available from the CRSP data set (370 banks), (ii) a portfolio of big banks (142 banks with asset size in April 1996 exceeding $1 billion) and (iii) a portfolio of small banks (228 banks with asset size in April 1996 of less than or equal to $1 billion).

The parameters of the market model were estimated over a one year (255 day) period ending 46 days before the event day using the EVENTUS software on WRDS[12]. To test the significance of the announcement day abnormal returns (*AR(0))* we used the Patell Z test.

As can be seen from Table 1, the market expected very different impacts for large versus small banks. For large banks the abnormal return on April 1st 1996 was positive 0.64% and significant at the 0.01% level, while for small banks the return was negative –0.09% and significant at the 10% level. For banks overall, the abnormal return was positive 0.19% and significant at the 5% level.

Thus there is evidence to suggest that the market believed that the news of the surcharge liberalization would have a material effect on (future) bank profitability and that the principal beneficiaries would be large banks. In the rest of the paper we examine whether the market's expectation was correct by employing Dove data and Call report data over the 1996-2001 period.

5. The Theoretical Model

To establish a framework for empirical analysis and hypotheses testing regarding the total, direct and indirect effects of bank ATM surcharges we utilize the theoretical framework of Massoud and Bernhardt (2002a and 2002b).

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[12] This is the standard window length option on Eventus.

In Massoud and Bernhardt (2002b) a spatial game is considered between two banks, *A* and *B*. Each bank is associated with a distinctive spatial line of length *Q* and each bank chooses the density of its ATM network on a distinctive line where ATM services can be obtained.

There is a measure *n* of bank customers. Customers are distinguished by how much they value one bank intrinsically. The relative valuation for *bank A* is uniformly distributed over the range *[-m,m]*. In addition to providing bank deposits and other products, banks provide ATM services for members and non-members (so called foreign users). First, customers establish a bank account at a local bank. Customers are then hit with a bank-specific location shock that is uniformly distributed over the range *[0,Q]*. Each customer receives incremental utility *M* from consuming bank services. The transportation cost of acquiring a service is *Td* where *d* is the distance traveled to the closest ATM and *T* is an incremental transportation cost. Each Bank chooses its own ATM network size, α_j, bank product charges, F^j and an ATM service fee to members and non-members, $P^j(\delta)$, where $\delta = 1$ for members and $\delta = 0$ for non-members[13]. Here bank product charges (F^j) are broadly defined to include returns from investing in assets (e.g. making loans) backed by relatively low cost deposits. Stavins (2002) among others argues that the fee banks charge their own customers for using their own ATM machines is invariably zero, so that ATM fees, here, are isomorphic to bank's ATM surcharges on foreign users.

5.1. Timing of the game:

Stage 1, *banks* maximize profits by choosing the density of their ATM locations and the prices charged for different services (e.g. ATM surcharge to foreign users).

Stage 2, each *customer* chooses a bank at which to establish an account.

Stage 3, *each customer* receives a bank-specific location shock and chooses where to obtain his/her ATM service.

The expected profit function of Bank *A* is

$$\pi_A = N_A F^A + N_B y^A(0)(p^A(0) - C_{ATM}) - \alpha_A C_\alpha,\text{[14]} \tag{1}$$

Where N_j is the number of bank *j's* customers, C_{ATM} is the marginal cost of providing ATM services to non-members, C_α is the cost of installing each ATM machine, $y^A(0)$ is the proportion of foreigners as customers, (i.e. bank *B* customers in this game using bank *A's* ATMs)

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[13] Here members are the depositors who hold deposit accounts at the bank.

[14] For simplicity, we consider a reduced form of the profit function where the in-branch service fee and the ATM service fees for members are set equal to their marginal cost.

and $p^A(0)$ is the ATM surcharge fee bank *A* charges bank *B* customers. The first term in equation (1) is the bank's profit from members use of bank products such as deposits and loans, the second term is the profit from non-members (i.e. foreigners) who use bank A's ATM services and the last term is the cost of installing the ATM network.

When a bank chooses its optimal ATM surcharge it takes into consideration how that surcharge would directly impact its profitability --which depends on foreign customers demand elasticity, as well as the indirect effects on its profitability as a result of switching. That is, the effect of ATM pricing on a bank's profitability can be decomposed into two effects: a direct effect and an indirect effect.

5.2. Bank Surcharge: The Direct and Indirect Effects

The effects of a marginal change in the ATM surcharges on a bank's profitability is shown by the following first order condition:

$$\frac{\partial \pi_A}{\partial p^A(0)} = \frac{\partial N_A}{\partial p^A(0)} F^A + \frac{\partial N_B}{\partial p^A(0)} y^A(0)(p^A(0) - C_{ATM}) + N_B \left(\frac{\partial y^A(0)}{\partial p^A(0)}(p^A(0) - C_{ATM}) + y^A(0) \right)$$

(2)

Where $\frac{\partial N_A}{\partial p^A(0)} > 0, \frac{\partial N_B}{\partial p^A(0)} < 0$ and $\frac{\partial y^A(0)}{\partial p^A(0)} < 0$

The first two terms in equation (2) show the indirect effect of ATM surcharges on bank A's profitability, where $\frac{\partial N_A}{\partial p^A(0)} F^A$ is the increase in bank-account membership and bank service purchases induced by a marginally higher surcharge times the bank product charges or profit extracted from other bank product provision, and $\frac{\partial N_B}{\partial p^A(0)} y^A(0)(p^A(0) - C_{ATM})$ is the loss in surcharge revenues from those foreign customers (i.e. bank B customers in this model) who switch bank-membership to bank *A,* due to the increase in ATM surcharges[15].

The last term in equation (2), $N_B \left(\frac{\partial y^A(0)}{\partial p^A(0)}(p^A(0) - C_{ATM}) + y^A(0) \right)$, shows the direct effect of ATM surcharges on bank A's profitability which is the impact of increasing ATM surcharges on surcharge profits from (foreign) customers who continue to establish bank accounts at competing

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[15] The bank does not charge a surcharge to its own members (depositors).

bank B. The third and last term in equation (2), or the direct effect, can be rewritten in terms of non-members ATM demand elasticity, ξ: $y^A(0)N_B\left(-\xi\frac{(p^A(0)-C_{ATM})}{p^A(0)}+1\right)$. The sign of this term depends on $sign\left(-\xi\frac{(p^A(0)-C_{ATM})}{p^A(0)}+1\right)$. If this term is non-negative, $\left(-\xi\frac{(p^A(0)-C_{ATM})}{p^A(0)}+1\right)\geq 0$, then it implies that $\xi\leq\frac{p^A(0)}{p^A(0)-C_{ATM}}$ and $\frac{p^A(0)}{p^A(0)-C_{ATM}}>1$. Given that in general a monopoly operates in a price region such that the elasticity exceeds one[16], then this inequality $1<\xi\leq\frac{p^A(0)}{p^A(0)-C_{ATM}}$ should hold which implies that ATM profits are positively related to ATM surcharges.

Note also that, $\frac{\partial N_A}{\partial p^A(0)}>0$, shows that an increase in the ATM surcharge increases a bank's customer base because of switching, that $\frac{\partial N_B}{\partial p^A(0)}<0$ shows that an increase in the ATM surcharge reduces a rival bank's customer base and $\frac{\partial y^A(0)}{\partial p^A(0)}<0$ shows that an increase in the ATM surcharge reduces a bank's market share of non-member (foreign) customers. Finally, in a related spatial model Massoud an Bernhardt (2002a) show that larger banks (with larger ATM networks) set higher ATM surcharges and generate more profits from customers than smaller banks through the sale of additional bank services.

6. Hypotheses

From the theoretical model in Section 5 in which a bank employs its surcharge level as a strategic variable to increase profitability either through a direct or indirect channel we can derive a number of testable hypotheses. Specifically, we test the following four hypotheses with respect to ATM surcharges and bank profitability:

6.1 Total Effect

Hypothesis 1:

If foreign users are relatively price inelastic (direct effect) and/or switching is sufficiently strong to overcome any loss in revenue if foreign users are price elastic (indirect effect), then overall bank profitability (*ROA* and *ROE*) will be increasing in ATM surcharge levels:

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[16] Tirole (1988), page 66, shows that when the elasticity of demand is less than one, the monopolist's revenue -- and his profits -- are decreasing in quantity.

$$H1: ROE_j = f(\overset{(+)}{p^j(0)}, \text{control variables})$$

$$ROA_j = g(\overset{(+)}{p^j(0)}, \text{control variables})$$

6.2 Indirect Effect

Hypothesis 2:

While a finding that overall profits are positively linked to surcharges is consistent with the presence of both direct and indirect effects we wish to investigate the indirect channel more deeply. In particular, a two-step process is required for the indirect channel. Consequently, we propose to test *H2* and *H3*:

$$H2: \qquad y^j(0) = h(\overset{(-)}{p^j(0)}, \text{control variables})$$

H2 is a hypothesis that involves the first step in the indirect channel, namely; higher surcharges ($p^j(0)$) can result in a lower proportion of foreign ATM users ($y^j(0)$) since foreign users have an incentive to switch to becoming bank customers (depositors) to avoid ATM surcharges. Thus, the relationship between foreign usage proportion and bank surcharge levels is expected to be negative. As discussed above, when we estimate this hypothesis, we control for possible changes in usage by foreign depositors.

Hypothesis 3:

$$H3: \quad Depositor\ growth_j = k(\overset{(+)}{p^j(0)}, \text{control variables})$$

$$Deposits_j = h(\overset{(+)}{p^j(0)}, \text{control variables})$$

$$Loans_j = i(\overset{(+)}{p^j(0)}, \text{control variables})$$

H3 reflects the second step in the indirect channel, namely; that ATM users who switch to become bank account holders consume more bank products and thus generate additional revenue for the bank. Here, we proxy for increased consumption of bank products by the change

in the number of depositors between t and t+1, and the dollar size of a bank's deposits and loans. Such consumption would potentially add to a bank's overall profitability.

6.3. Large versus Small Banks

H4: The impact of surcharges in *H1* to *H3* above, with regard to overall bank profitability and the indirect channel, is stronger for large banks than small banks. Such a finding would be consistent with the view of many public policy advocates and legislators[17] that freeing surcharges has resulted in strategic use of ATM prices to the benefit of large banks over small banks. This is because consumers have an incentive to switch from smaller to larger banks with more extensive ATM networks in order to avoid paying surcharges.

7. Empirical Methodology and Results

An Appendix to this paper provides a detailed description of data used in this study. As discussed there the empirical tests of the overall and the indirect effect of ATM surcharges on bank profitability over the period 1996-2001 are based on underlying survey data generated by Dove Consulting of Boston in two reports on ATM deployment and pricing– the first in 1999 and the second in 2002. These data provide specific details by bank and year regarding ATM surcharge, ATM network size, transactions per ATM, percent use of a bank's ATM network by foreigners as well as other pertinent ATM related data. As discussed in the Appendix not every variable was available each year and the sample of banks differed over the 1999 and 2002 surveys. Nevertheless, these data are sufficiently rich to allow us to examine the impact of ATM surcharges on bank profitability as well as to gain an understanding of the indirect channel through which ATM pricing affects bank profitability.

To gain insights into the overall and indirect channels resulting from ATM surcharges we employ bank Call Report data and Federal Reserve generated bank market share data in addition to Dove data.[18] The Call Reports used were those that most closely matched the dates of the Dove surveys. The variables derived from Call Reports were growth in number of depositors for accounts less than $100,000, dollar value of loans and dollar value of deposits as dependent variables in the indirect channel tests. And, as independent or control variables, we derived a measure of bank risk (the bank capital-asset ratio) and size (bank assets).

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[17] As well as the model of Massoud and Bernhardt (2002a).
[18] The market share variable used in these tests was the percent of the bank's deposits relative to total deposits in the State in which the bank's headquarters is located.

As additional control variables we included the number of transactions per ATM and the size of the bank's ATM network (number of ATMs). We also included a measure of geographic dispersion of a bank's ATM network. Dove consulting divides the U.S. into 7 regions and identifies whether a bank has ATMs in each region and outside the U.S. (internationally) -- making 8 possible regions in all. The geographic dispersion variable takes a value between one and eight, where the value of this variable reflects the sum of the regions over which a bank locates its ATMs. The Appendix discusses in more detail the different regions identified in the Dove surveys.

In testing hypotheses *H1* to *H4* we employ both fixed and random effect tests of the impact of ATM surcharges on the various dependent variables of interest (bank profits, demand for other bank products and switching). To determine the best fitting model we employ the Hausman test statistic. The null hypothesis under the Hausman test statistic is whether the random effects model is appropriate. In such cases we report the fixed effects model. We report only the most appropriate model (random effects or fixed effects) according to the Hausman test. For each panel model test we report the R^2 within, which measures the proportion of the variance explained by variation within groups (here banks over time), R^2 between, which measures the proportion of the variance explained by variation between groups (banks), and the total $R^{2.}$ for the panel.

For all four hypothesis we estimated both contemporaneous results (i.e. where the dependent variable is measured in the same year as the independent or control variables) and results when the dependent variable is one year ahead of the independent variables --which are labeled "Lead". There are two reasons why we believe that the lead results offer a better test of the link between ATM surcharges and bank profitability. First, the lead results capture causality in the relationship by focusing on how a change in ATM surcharge in one year impacts the dependent variables (e.g. profitability) one year later. Second, the lead equations also capture any likely depositor or customer frictions, in that it may take a period of time for customers to process the fact that a bank has changed its ATM surcharge. Thus, in general, we report the lead variable results in the Tables.[19] Nevertheless, the results relating to the significance of the ATM

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[19] Where not reported the results of tests using contemporaneous values of the dependent variables are available from the authors on request.

surcharge variable are generally similar in both the lead and the contemporaneous regressions. Tables 2 to 8 report the empirical tests of hypotheses *H1* to *H4* discussed above.

7.1. Results of the Effects on Total Profitability *(H1)* and Large versus Small Bank *(H4)*

Tables 2 and 3 show, respectively, the effects of surcharge change in one year on bank *ROA* and *ROE* in the next year. As can be seen a striking result in both tables is the positive and statistically significant impact of bank surcharge on bank profitability. Specifically, Table 2 suggests that a $1 dollar increase in a bank's surcharge (e.g. from 50 cents to $1.50) increases bank *ROA* by 0.17%, while from Table 3 an increase in surcharge by $1 leads to an increase in bank *ROE* by 2%. As noted earlier, this positive total effect may be due to either a direct effect and/or an indirect effect --reflecting customer switching. With respect to big versus small banks (i.e. those banks with over $1billion in assets versus those with assets $1billion or less) there is a clear size effect. Specifically, for both *ROA* and *ROE* the surcharge variable has a strongly positive and statistically significant impact on large banks *ROA* and *ROE* while for small banks the impact is insignificantly different from zero for both profitability measures. This suggests that the equity markets *ex-ante* expectation of a relatively favorable effect on large bank profitability resulting from surcharge liberalization was confirmed over the 1996-2001 period.

7.2. Results for the Indirect Channel for all Banks (*H2* and *H3*) and for Large versus Small Banks (*H4*)

Tables 4 and 5 show the sensitivity of foreign (non-bank) ATM users to a bank's ATM surcharge. As can be seen in both Tables 4 and 5, for all banks the surcharge variable is significantly negative at the 10% level or better. That is, a higher surcharge results in a lower foreign percentage usage, which is consistent with customer switching and supports *H2* (it is also the first step in the indirect channel). Moreover, since switching can be quite fast, occurring contemporaneously in the year of the surcharge change or be delayed due to transactional frictions (i.e. switching occurs in the following (or lead) year), it is of interest that both the lead tests (Table 4) and the contemporaneous tests (Table 5) support a significant impact of ATM surcharges on customers switching behavior (i.e. high surcharges induce customers to switch to the high ATM surcharge bank). However, it appears that the surcharge variable is more

significant in the contemporaneous tests than the lead tests –suggesting that switching takes place quite fast.

With respect to *H4*, and large versus small bank customer switching, the surcharge variable is significantly negative at the 1% level for large banks in the contemporaneous regression but is negative and insignificantly different from zero for small banks. Thus, the data support a more powerful switching effect for large banks consistent with *H4*.

As described above, a finding of an increase in surcharge lowering the foreign percentage can be the result of either customers switching or foreigners using other bank's ATMs less as the surcharge increases. We attempt to control for the second possibility by controlling for ATM usage. In Tables 5 and 5a we have two different measures of ATM usage respectively, total ATM transactions per ATM, as well as foreign ATM transactions per ATM (defined as total ATM transactions times the foreign percentage).

As can be seen in both Tables 5 and 5a, the surcharge variable is highly significant and negative for large banks, but insignificant for small banks. Furthermore, as discussed in the introduction, switching is a two-part story. A finding that a surcharge increase will reduce the foreign percentage, coupled with a finding that a surcharge increase will increase the demand for other bank products (e.g. loans and deposits) will be consistent with the switching story.

Tables 6, 7, and 8 seek to test the second step in the indirect channel (hypothesis *H3*), *i.e.,* once a customer has switched do we see an expansion in customer demand for bank products?

Table 6, analyses the growth in the number of bank depositors (with under $100,000) between time *t* and *t+1*, i.e., on a year-by-year basis. As can be seen the sign of the coefficient of ATM surcharges on depositor growth is significantly positive for all banks, i.e. a high bank ATM surcharge is associated with a higher depositor growth rate in the succeeding year. Thus for all banks the second link in the indirect channel implied by *H3* has support. When the data is split into large versus small banks it can be seen that the surcharge variable is significantly positive for large banks at the 5% level but is insignificantly different from zero for small banks. Again to the extent that the indirect channel works, it appears to work mostly through large banks, a result consistent with *H4*.

Tables 7 and 8 analyze the effects of bank surcharge on the quantity (measured in dollars) of specific bank products. For the dollar value of loans and deposits, where one year lead values

of these variables are used as dependent variables, the bank ATM surcharge variable is positive and statistically significant[20].

This adds further support to *H3* and the presence of an indirect effect of ATM surcharges on bank profitability. Tables 7 and 8 also show a more significant effect of ATM surcharge on large bank deposits and loans in the succeeding year than for small banks. A result supportive of the indirect channel being relatively stronger for large banks consistent with *H4.*

7.3. Robustness Checks

A number of robustness checks were also conducted with respect to the results in Tables 2 to 8. We estimated the model using various interaction variables. Most notably, ATM network size was interacted with surcharge as well as bank asset size with surcharge. These (interactive) variables did not change the explanatory power of the surcharge variable in the presence of bank asset size and the large versus small bank sample split. We also estimated various alternative instruments for the bank surcharge variable by regressing it (using panel techniques) on various size related and other variables; specifically, asset size, ATM network size and geographic dispersion. Using these instruments in the tests, instead of surcharge, did not significantly change the results. Indeed, in many cases the statistical significance of the surcharge instrumental variable was higher. Overall, the impact of surcharge on bank profitability, switching and bank products appeared to be robust to alternative specifications.

8. Summary and Conclusion

This paper has modeled and tested the relationship between a bank's foreign-user ATM surcharge and its overall profitability. An important aspect of this paper was to identify and test for an indirect (or customer relationship) channel linking surcharge levels to bank profitability. Using unique data sets provided by Dove Consulting which contained both time-series as well as cross-sectional information on bank ATM surcharges and other ATM related variables, it was found that there is evidence consistent with customer switching and thus the indirect channel. Specifically, higher ATM surcharge levels were associated with greater depositor growth, greater deposit amounts and greater loan amounts. In addition, foreign ATM users seemed to be averse

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[20] The surcharge variable is also significant in both contemporaneous tests for deposits and loans.

to high surcharge levels, such that high surcharge levels may have induced foreign users to switch to becoming account holders of the high foreign surcharge bank. Finally, consistent with the equity markets *ex-ante* expectations, with respect to ATM surcharge liberalization, larger banks appear to have benefited far more than smaller banks. This suggests that public policy concerns regarding the negative effect of liberalizing ATM surcharges on smaller banks have some merit.

Appendix

Data

        An important aspect of this paper lies in the uniqueness of the ATM data set employed in our tests. This data set was purchased from Dove Consulting Inc., Boston, and includes bank level data on a range of variables that have not previously been used in the empirical ATM literature. In particular, the data includes a measure of the percentage of ATM users for different banks who are foreigners – i.e., those who pay ATM surcharges. This variable, in conjunction with other data such as surcharge amount and ATM network size, allows us to test the hypotheses discussed in the paper. The Dove Survey data is used in conjunction with a variety of other publically available sources of bank level data, including Call Reports (Report of Condition and Income) taken from the Federal Reserve's web site as was Market Share data.

        The data base provided by Dove Consulting is taken from two separate surveys of ATM providers --one taken in 1998 and the second in 2001(The Dove Reports themselves were published in 1999 and 2002 respectively). In each case data were collected from each bank in the sample for the preceding three years generating a 6-year sample that spans 1996-2001. The two surveys are not identical across the two time periods, thus some data are available for some of the time periods only. For example, while each of the two Dove surveys asked respondents for information on a variety of variables for each of the preceding three years, this was not the case for the foreign percentage variable. The first survey conducted during 1998 did ask for this data for each of the preceding 3 years, however, the second survey only asked the respondents for this data for the final year of that survey *i.e.,* 2001. In other words, in some of our empirical tests, e.g. those which require the use of the foreign percentage variable, we use a data set made up of a given set of banks for each of 1996, 1997 and 1998 and different banks in 2001.

        A further issue with our data concerns how the banks were asked to report their ATM surcharges over the preceding three years. In the case of both the 1998 and 2001 surveys, banks were asked to provide data on their ATM surcharges at the time of the survey. They were also asked to provide the date of the last change of the surcharge and how much that change was (in dollars and cents). This information is enough to create a partial historical record of surcharges charged by each bank. For example, if the date of the previous surcharge change occurred prior to the three-year period covered by the survey, then we are able to use the value of the surcharge

in the final year of the survey for all of the previous three years. Similarly, if the most recent surcharge change occurred during the preceding three years we are able to infer surcharges after that date. However, we would not be able to infer surcharges outside the three-year window of each data set. In cases where we are not able to infer the surcharge amount from the data, we do not use the data.

Another variable employed is the measure of geographic dispersion of a bank's ATM network. Dove divides the U.S. into 7 regions and identifies whether each bank (in each year) has an ATM in one of those regions plus whether ATMs are held internationally (making 8 regions). The 7 U.S. regions identified were New England, Mid-Atlantic, Southeast, South, Midwest, Mountain and Pacific (see Dove, 1999, p. 27). The geographic dispersion variable takes a value between one and eight, where the value of the variable reflects the sum of the regions where a bank locates its ATMs. For example, if geographic dispersion is equal to one, it indicates an ATM presence in only one region and if it is higher than one it indicates presence in more than one region.

In Table A1 below we provide a summary table of the data used in the paper:

Table A 1: Descriptive Statistics

Variable	Obs	Mean	Std Dev	Min	Max
Return on Equity	360	8.31	5.21	-9.69	34.63
Return on Assets	360	0.68	0.49	-4.06	3.07
Change in number of Depositors	355	524.43	8569.85	-100.00	161178.50
Total Loans ($M)	360	12300	42400	1.751	391000
Total Deposits ($M)	360	10100	32000	1.244	317000
Foreign Percentage	204	37.75	16.33	5.00	100.00
Surcharge	329	1.22	0.49	0.00	2.00
Number of ATMs	358	564.59	1579.94	0.00	14249.00
Transactions per ATM (pm)	315	4322.02	6410.67	4.47	59235.90
Foreign Transactions per ATM (pm)	201	1325.62	1005.68	1.72	10592.42
Capital Ratio	360	9.35	5.23	0.98	54.46
Assets ($M)	360	19900	68100	9.45	607000
Market Share	357	6.09	12.76	0.00	189.00
Geographic Dispersion	363	1.69	1.40	1.00	8.00

Table 1:
Abnormal Return on Event Day (Day Zero) of Cirrus/Plus Announcement Freeing Restraints on ATM Surcharges (April 1, 1996)

	All Banks	Big Banks (Assets> $1B)	Small Banks (Assets< $1B)
Abnormal Return (Day Zero)	0.19%	0.64%	-0.09
Patell Z Test	2.233**	5.442****	-1.407*
Number of Banks	370	142	228

*   indicates significance at 10%
**   indicates significance at 5%
***   indicates significance at 1%
**** indicates significance at 0.01%

Data taken from all banks in Compustat Bank File who have event day returns data available from CRSP Dataset. Asset size determined from Compustat as at 1996. Return on Market Model with Equally Weighted Index. Market Model estimated over 255 days in length, ending 46 days before event day. Estimation conducted using EVENTUS software.

Table 2:

The Relationship Between ATM Surcharge and *ROA* (Lead), 1996-2001

	All Banks	Std Error	Big Banks (Assets> $1B)	Std Error	Small Banks (Assets< $1B)	Std Error
Surcharge	0.1737***	0.0454716	0.274088***	0.05812	-0.01485	0.067487
Number of ATMs	7.62E-06	0.0000372	-1.2E-05	3.72E-05	-0.0006	0.000515
Geographic Dispersion	0.037714	0.0287631	0.043258	0.031221	0.015392	0.059842
Transactions per ATM	5.87E-06	4.34E-06	1.04E-05**	5.13E-06	-4.09E-06	6.51E-06
Bank CapitalRatio	0.006841	0.0056544	0.033344***	0.011111	0.001575	0.005578
Bank Assets	3.20E-13	6.78E-13	3.11E-13	6.69E-13	4.27E-11	1.43E-10
Market Share	-0.00017	0.0010936	-0.00051	0.001083	0.175082	0.071747
Constant	0.3358***	0.0973816	-0.00151	0.134578	0.541832***	0.152274
Sample Size	276		182		94	
R^2 Within	0.09		0.16		0.02	
R^2 Between	0.12		0.29		0.19	
R^2 Overall	0.09		0.19		0.16	
Hausman Test χ^2	9.54(0.21) Random effects is appropriate estimator		13.5 (0.06) Random effects is appropriate estimator		1.69 (0.94) Random effects is appropriate estimator	

***   Indicates p value of 1%

**   Indicates p value of 5%

*   Indicates p value of 10%

(.)   Indicates p value

Table 3:
The Relationship Between ATM Surcharge and *ROE* (Lead), 1996-2001

	All Banks	Std Error	Big Banks (Assets> $1B)	Std Error	Sml Banks (Assets< $1B)	Std Error
Surcharge	2.06423***	0.6466082	2.9994***	0.910303	0.443974	0.733256
Number of ATMs	-0.0002266	0.0004920	-0.00022	0.00055	-0.00463	0.005913
Geographic Dispersion	0.1826976	0.3781347	0.134643	0.457946	-0.05633*	0.680839
Transactions per ATM	0.0000671	0.0000555	0.000113	7.25E-05	-4.8E-05	7.48E-05
Bank CapitalRatio	-0.26407***	0.0728048	-0.512***	0.170418	-0.12888	0.065657
Bank Assets	8.32e-12	9.31E-12	6.16E-12	1.03E-11	5.42E-10	1.66E-09
Market Share	0.0321767*	0.0169702	0.029857	0.018978	2.635193	0.846413
Constant	7.5169910***	1.3155360	8.668368	2.050562	6.671345	1.729184
Sample Size	276		182		94	
R^2 Within	0.07		0.12		0.01	
R^2 Between	0.18		0.15		0.36	
R^2 Overall	0.17		0.15		0.35	
Hausman Test χ^2	9.57 (0.2141) Random effects is appropriate estimator		6.15 (0.52) Random effects is appropriate estimator		3.58(0.73) Random effects is appropriate estimator	

***   Indicates p value of 1%
**   Indicates p value of 5%
*   Indicates p value of 10%
(.)   Indicates p value

Table 4:
The Relationship Between ATM Surcharge and Foreign Percentage (Lead), 1996-2001

	All Banks	Std Error	Big Banks (Assets> $1B)	Std Error	Small Banks (Assets< $1B)	Std Error
Surcharge	-8.365*	5.04634	-3.36762	3.188478	-35.9697	20.33343
Number of ATMs	-0.01088	0.0112	-0.00251	0.003071	-0.57991	0.537001
Geographic Dispersion	-0.45271	5.5607	0.807938	1.790671	N/A	N/A
Transactions per ATM	-0.00092	0.0013	-0.00018	0.000232	-0.04088**	0.010593
Bank CapitalRatio	225.3731**	111.3641	-0.43981	1.117792	3.832835	3.397254
Bank Assets	1.33E-10	1.E-10	2.88E-11	9.51E-11	-2.74E-07	2.91E-07
Market Share	1.635177	1.0391	-0.19803	0.186232	63.81943	76.98086
Constant	22.43404	16.6152	42.82169	11.77845	228.4608*	120.8998
Sample Size	118		76		42	
R^2 Within	0.41		0.04		0.74	
R^2 Between	0.01		0.17		0.13	
R^2 Overall	0.02		0.09		0.10	
Hausman Test χ^2	14.46(0.04) Random effects is inappropriate estimator		12.57(0.08) Random effects is appropriate estimator		20.80(0.00) Random effects is inappropriate estimator	
*** Indicates p value of 1% ** Indicates p value of 5% * Indicates p value of 10% (.) Indicates p value N/A. Because small banks were not geographically dispersed enough and there was insufficient variability across banks this variable was dropped in the small bank tests in this sample.						

Table 5:
The Relationship Between ATM Surcharge and Foreign Percentage (current), 1996-2001

	All Banks	Std Error	Big Banks (Assets> $1B)	Std Error	Small Banks (Assets< $1B)	Std Error
Surcharge	-6.28685***	2.133036	-15.21***	3.534165	-3.5679	4.18162
Number of ATMs	-0.00096	0.00179	0.000186	0.004107	-0.0082	0.032537
Geographic Dispersion	-0.07767	1.328582	-10.6369***	3.131837	1.641058	3.749934
Transactions per ATM	-0.00059***	0.00024	0.000794	0.000749	-0.00124	0.001185
Bank CapitalRatio	0.06763	0.256811	-3.60596**	1.649817	0.085686	0.377879
Bank Assets	-4.40E-12	3.13E-11	8.92E-11	6.91E-11	-1.55E-08	1.02E-08
Market Share	-0.17791	0.169284	0.157002	0.496199	-0.32102	1.005671
Constant	47.73202***	4.691936	97.13029	16.8455	51.9169***	10.32471
Sample Size	182		113		69	
R^2 Within	0.11		0.51		0.00	
R^2 Between	0.15		0.00		0.15	
R^2 Overall	0.13		0.01		0.21	
Hausman Test χ^2	5.98(0.54) Random effects is appropriate estimator		23.53(0.00) Random effects is inappropriate estimator		1.89(0.92) Random effects is appropriate estimator	

*** Indicates p value of 1%
** Indicates p value of 5%
* Indicates p value of 10%
(.) Indicates p value

Table 5a:
The Relationship Between ATM Surcharge and Foreign Percentage (current), 1996-2001 (Foreign Transactions per ATM as a control variable).

	All Banks	Std Error	Big Banks (Assets> $1B)	Std Error	Small Banks	Std Error
Surcharge	-3.98876	2.646505	-12.258***	3.216126	2.354868	3.861406
Number of ATMs	-0.00154	0.004583	8.99E-05	0.00359	-0.01765	0.027916
Geographic Dispersion	-10.3522***	3.513204	-11.7281***	2.726781	-0.07047	3.25748
Foreign Transactions per ATM	0.007296***	0.00149	0.00584***	0.001544	0.010251***	0.002328
Bank CapitalRatio	-0.32749	1.01139	-2.83612*	1.466711	-0.04213	0.325147
Bank Assets	9.56E-11	7.64E-11	9.71E-11	6.07E-11	-1.88E-08**	8.63E-09
Market Share	0.00792***	0.426391	0.195973	0.427643	0.112759*	0.894473
Constant	51.81854***	11.97603	83.89472***	15.25854	34.66554***	9.203405
Sample Size	182		113		69	
R^2 Within	0.36		0.61		0.21	
R^2 Between	0.00		0.01		0.39	
R^2 Overall	0.03		0.03		0.44	
Hausman Test χ^2	17.26(0.01) Random effects is inappropriate estimator		41.75 (0.00) Random effects is inappropriate estimator		7.60(0.26) Random effects is appropriate estimator	

***   Indicates p value of 1%
**   Indicates p value of 5%
*   Indicates p value of 10%
(.)   Indicates p value

Table 6:
The Relationship Between ATM Surcharge and Change in the Number of Bank Depositors, 1996-2001

	All Banks	Std Error	Big Banks (Assets> $1B)	Std Error	Small Banks (Assets< $1B)	Std Error
Surcharge	50.3209*	26.13786	82.13017**	41.48083	15.37865	22.33711
Number of ATMs	0.0990**	0.0385	0.089001**	0.044687	0.433808	0.706343
Geographic Dispersion	111.5937***	33.10758	113.4618***	39.04001	-43.6143	96.26599
Transactions per ATM	-0.00114	0.006	-0.00801	0.010581	0.00229	0.0044
Bank CapitalRatio	-4.04919	8.0505	-8.36758	11.3235	1.642042	6.640426
Bank Assets	-3.E-09***	6.5E-10	-2.9E-09***	7.55E-10	-1.90E-07	1.65E-07
Market Share	-1.333**	0.5284	-1.22431**	0.609154	-13.0338	8.494056
Constant	-166.273*	96.73478	-186.337	130.0116	163.6215	171.4575
Sample Size	268		175		93	
R^2 Within	0.21		0.25		0.08	
R^2 Between	0.00		0.00		0.03	
R^2 Overall	0.00		0.02		0.01	
Hausman Test χ^2	7.65(0.014) Random effects is inappropriate estimator		25.55(0.00) Random effects is inappropriate estimator		1.15(0.97) Random effects is appropriate estimator	

*** Indicates p value of 1%
** Indicates p value of 5%
* Indicates p value of 10%
(.) Indicates p value

Table 7:
The Relationship Between ATM Surcharge and Dollar Value of Bank Loans (Lead), 1996-2001

	All Banks	Std Error	Big Banks (Assets> $1B)	Std Error	Small Banks (Assets< $1B)	Std Error
Surcharge	6.73E+09**	2.80E+09	1.23E+10***	4.67E+09	1.34E+08	1.24E+08
Number of ATMs	2.35E+07***	4162531	2.20E+07***	5105081	-2.E+07***	5964628
Geographic Dispersion	5.05E+09	3.57E+09	3.98E+09	4.44E+09	N/A	N/A
Transactions per ATM	196391.1	642715.6	242745.2	1191880	-5889.235	26011.16
Bank CapitalRatio	-2.06E+09**	8.46E+08	-3.07E+09**	1.27E+09	-7160013	4.65E+07
Bank Assets	-0.0266869	0.070348	0.001014	0.086113	-1.740657	1.165918
Market Share	-2.08E+07	5.70E+07	-3623633	6.95E+07	1.90E+08**	6.34E+07
Constant	2.11E+09	1.03E+10	1.75E+09	1.48E+10	1.34E+09	7.18E+08
Sample Size	278		183		95	
R^2 Within	0.75		0.75		0.24	
R^2 Between	0.47		0.51		0.00	
R^2 Overall	0.59		0.62		0.00	
Hausman Test χ^2	283.024(0.00) Random effects is inappropriate		239.30(0.000) Random effects is inappropriate		18.60(0.00) Random effects is inappropriate	

***   Indicates p value of 1%
**   Indicates p value of 5%
*   Indicates p value of 10%
(.)   Indicates p value
N/A. Because small banks were not geographically dispersed enough and there was insufficient variability across banks this variable was dropped in the small bank tests in this sample.

Table 8:
The Relationship Between ATM Surcharge and Dollar Value of Bank Deposits (Lead), 1996-2001

	All Banks	Std Error	Big Banks (Assets> $1B)	Std Error	Small Banks (Assets< $1B)	Std Error
Surcharge	4.98E+09*	2.64E+09	9.06E+09**	4.45E+09	8.21E+07	7.67E+07
Number of ATMs	1.09E+07***	3933569	9676405**	4862513	-1.19E+7***	3687363
Geographic Dispersion	7.42E+09**	3.37E+09	6.64E+09	4.23E+09	N/A	N/A
Transactions per ATM	91173.39	607362.8	65012.23	1135248	-2690.629	16080.23
Bank CapitalRatio	-1.65E+09**	8.00E+08	-2.50E+09**	1.21E+09	549617.1	2.88E+07
Bank Assets	0.25841***	0.066479	0.2808756***	0.082022	-0.9724481	0.720777
Market Share	-3.91E+07	5.38E+07	-2.55E+07	6.62E+07	1.09E+08***	3.92E+07
Constant	-2.18E+09	9.71E+09	-2.26E+09	1.41E+10	8.67E+08*	4.44E+08
Sample Size	278		183		95	
R^2 Within	0.81		0.81		0.22	
R^2 Between	0.72		0.75		0.00	
R^2 Overall	0.73		0.77		0.00	
Hausman Test χ^2	21.21(0.00) Random effects is inappropriate estimator		14.84 (0.03) Random effects is inappropriate estimator		19.09(0.00) Random effects is inappropriate estimator	

*** Indicates p value of 1%
** Indicates p value of 5%
* Indicates p value of 10%
(.) Indicates p value
N/A. Because small banks were not geographically dispersed enough and there was insufficient variability across banks this variable was dropped in the small bank tests in this sample.

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